Chapter 3:
Patterns, Relations, Equations and Predictions

- Describing Patterns
- Solving Equations (algebra)
- y = mx + b

Oct 12-1:55 PM

Section 3.1 - Describing Patterns

Curriculum Outcomes	Related Activities	Page in Text
• express problems in terms of equations and vice versa • model real-world phenomena with linear, quadratic, exponential, and power equations • gather data, plot the data using appropriate scales, and demonstrate an understanding of independent and dependent variables and domain and range • construct and analyze tables relating two variables • develop and apply strategies for solving problems • describe real-world relationships depicted by graphs and tables of values • identify, generalize, and apply patterns • solve problems using graphing technology • determine if a graph is linear by plotting points in a given situation	• investigations on gathering data about visible faces on cube "trains" • a Focus on graphing data and using data to make predictions • develop an equation in the form ax + b = c • demonstrate and apply an understanding of discrete and continuous number systems	96 97 98 101

Oct 12-1:51 PM

THE NUMBER SYSTEM

W =	Whole Numbers	I =	Integers
$\overline{Q}$ =	Irrational Numbers	R =	Real Numbers
N =	Natural Numbers	Q =	Rational Numbers

EXAMPLES:

W: 0, 1, 2, 3, ...

$\overline{Q}$: π (3.141592...), $\sqrt{3}$, 1.23456738... , $\sqrt{15}$, ...

N: 1, 2, 3, ...

I: ....-3, -2, -1, 0, 1, 2, 3, ...

R: $-\frac{1}{2}$, $\sqrt{15}$, 0 , -3 , 3 , π (3.141592) , ...

Q: $\frac{1}{2}$, $-\frac{1}{2}$, $\frac{11}{3}$, 0.2 , -0.2 , 3 , -3 , 0 , ...

Apr 28-9:05 AM

- **Definitions**

- Real numbers (R): ALL numbers; rational & irrational
- Irrational numbers ($\overline{Q}$):
  - -they cannot be written as a fraction
  - -non-repeating decimal
  - -non-terminating decimal
  - -Examples: 0.21638759 43.... and π
- Rational numbers (Q):
  - -a number that can be written as a fraction
  - -Any number that is not an irrational number
  - -Examples: -2.34, $3.\overline{456}$, 6.323 232 32...

Sep 3-6:11 PM

Definitions continued...

- Integers (I):
  - -Positive and negative whole numbers
  - -NO decimals
  - -Examples: -400, +8, 0, 29, -49578
- Whole numbers (W):
  - -all of the positive integers and zero
  - -Examples: 0, 1, 2, 3, 4, etc.
  - -NO decimals
- Natural numbers (N):
  - -all of the positive integers
  - -DOES NOT include zero (only difference from whole numbers)
  - -Examples: 1, 2, 3, 4, etc.

Sep 3-6:49 PM

Using the previous definitions, determine if the following statements are sometimes true, always true, or never true. Justify your choices.

A) All whole numbers are integers

B) All integers are whole numbers

C) If a number is an integer then it is also a rational number.

D) If a number is a rational number then it is also an integer.

E) There is a number which is both rational and irrational.

Sep 3-6:54 PM

Copy and complete the table:

For each of the following numbers in the table, put an "x" in each category that the number belongs to. It may only belong in one, but could also belong to 5 out of the 6 categories. The first one is done for you.

Number	Real	Rational	Irrational	Whole	Natural	Integer
3.2	x	x				
0						
5.66						
-7						
15						
20009						
4.569...						
3.14...						
-3.22						
4/5						
14/2						
-6/3						
5/2						
-4.567...						
-23						
10						

Sep 3-6:59 PM

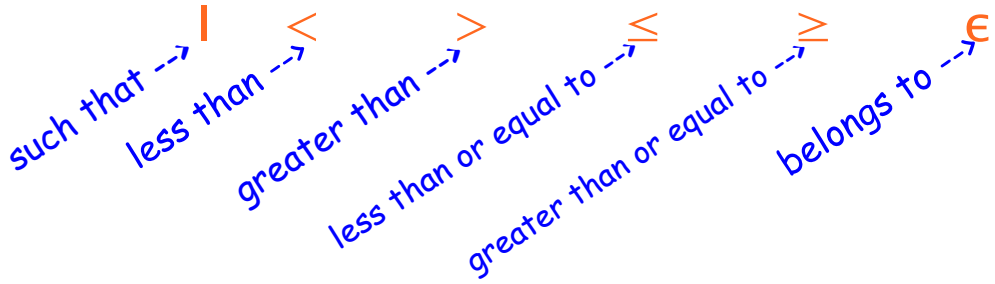
Please double check your answers to make sure that you marked the appropriate boxes.

Number	Real	Rational	Irrational	Whole	Natural	Integer
3.2	X	X				
0	X	X		X		X
5.66	X	X				
-7	X	X				X
15	X	X		X	X	X
20009	X	X		X	X	X
4.569...	X		X			
3.14...	X		X			
-3.22	X	X				
4/5	X	X				
14/2	X	X		X	X	X
-6/3	X	X				X
5/2	X	X				
-4.567...	X		X			
-23	X	X				X
10	X	X		X	X	X

Sep 3-7:25 PM

Set Notation:

- We need to know what these signs mean?



- We need to know what number type we are dealing with?

Natural Number = N	Rational Numbers = Q
Whole Numbers = W	Irrational Numbers = $\overline{Q}$
Integer = I	Real Numbers = R

- Example:

$$\{ x \mid x \leq 5, x \in I \}$$

Oct 12-2:17 PM

What if we were to graph this on a number line?

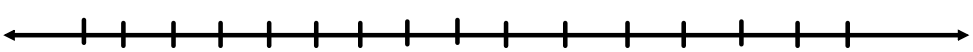
Ask Yourself:

- What set of numbers am I dealing with?
- What is the sign?: am I going right or left?
- Dots or a line?:

Dots	Lines
Integers	Real
Natural	Irrational
Whole	Rational

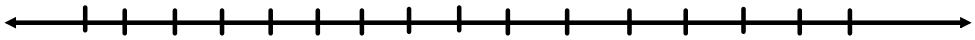
- Solid or open dots?:
  - Solid - most of the time
  - Open - Only use with real numbers

$$\{ x \mid x \leq 5, x \in I \}$$

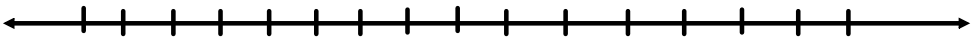


Oct 12-3:00 PM

Example #2: $\{ x / x > 3, x \in R \}$



Example #3: $\{ x / x < 2, x \in W \}$



Oct 12-3:17 PM

Class work / Homework:

Copy and Complete the following:

Section 3.1 – "Graphing Number Lines"

1. What set of numbers do the following represent?

a) N b) Q c) Q d) R e) W f) I

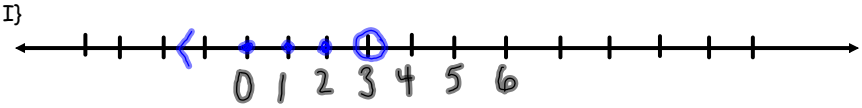
2. Graph the following on a number line. Use a ruler to draw the line.

a) $\{x / x < 3, x \in I\}$ b) $\{x / x < 3, x \in R\}$ c) $\{x / x \geq 2, x \in N\}$
d) $\{x / x \geq 2, x \in I\}$ e) $\{x / x < -3, x \in R\}$ f) $\{x / x < -3, x \in I\}$
g) $\{x / x < 4, x \in W\}$ h) $\{x / x \geq 0, x \in R\}$ i) $\{x / 0 < x, x \in I\}$
j) $\{x / 0 < x, x \in R\}$ k) $\{x / 9 > x, x \in R\}$ l) $\{x / 9 > x, x \in N\}$

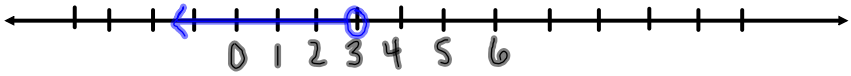
Oct 12-3:31 PM

Answers:

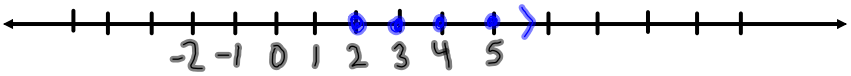
a) {x / x < 3, x ε I}



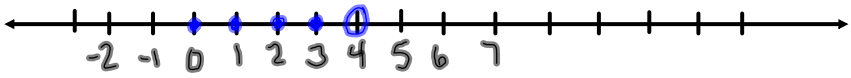
b) {x / x < 3, x ε R}



c) {x / x ≥ 2, x ε N}



g) {x / x < 4, x ε W}



No arrow and
no dots on the negatives
because whole numbers
are not negative.

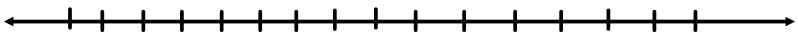
Oct 13-2:44 PM

a) {x / x < 3, x ε I} b) {x / x < 3, x ε R} c) {x / x ≥ 2, x ε N}

d) {x / x ≥ 2, x ε I} e) {x / x < -3, x ε R} f) {x / x < -3, x ε I}

g) {x / x < 4, x ε W} h) {x / x ≥ 0, x ε R} i) {x / 0 < x, x ε I}

j) {x / 0 < x, x ε R} k) {x / 9 > x, x ε R} l) {x / 9 > x, x ε N}



Oct 16-8:44 AM

State what type of number system each of the following sets of numbers would fall under:

a) {-2, -1, 0, 3, 5, 7}
b) {-4.5, -2, -0.5, 0, 0.5, 6}
c) {0, 2, 4, 6, 8}
d) {2, 4, 6, 8, 10, 12}
e) {1/2, 1/4, 0.75}
f) {π, $\sqrt{2}$, 5.48295727161530384620278 4}

Oct 16-8:43 AM

Warm Up:

1. State what type of number system each of the following sets o numbers would fall under:

a) {-2, -1, 0, 3, 5, 7}
b) {-4.5, -2, -0.5, 0, 0.5, 6}
c) {0, 2, 4, 6, 8}
d) {2, 4, 6, 8, 10, 12}
e) {1/2, 1/4, 0.75}
f) {π, $\sqrt{2}$, 5.48295727161530384620278 4}

2. Graph the following on a number line:

a) $\{x \mid x \leq 5, x \in I\}$ b) $\{x \mid x < 2, x \in W\}$

c) $\{x \mid x \leq 3, x \in N\}$ d) $\{x \mid x < 2, x \in N\}$

Oct 13-9:27 PM

Modeling:

- a technique of producing a mathematical description or model that can be used to solve a practical problem
- modeling can be done through the use of:

1. Equations

Example: y = 2x

2. Table of values

Example:

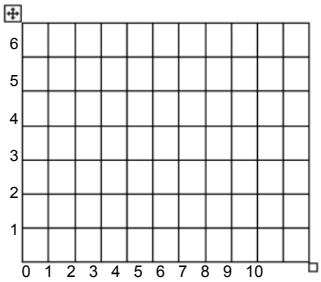
X	Y

3. Ordered Pairs

Example: (0, 0) (1, 2) (2, 4) (3, 6)

4. Graphing

Example:



Oct 13-1:24 PM

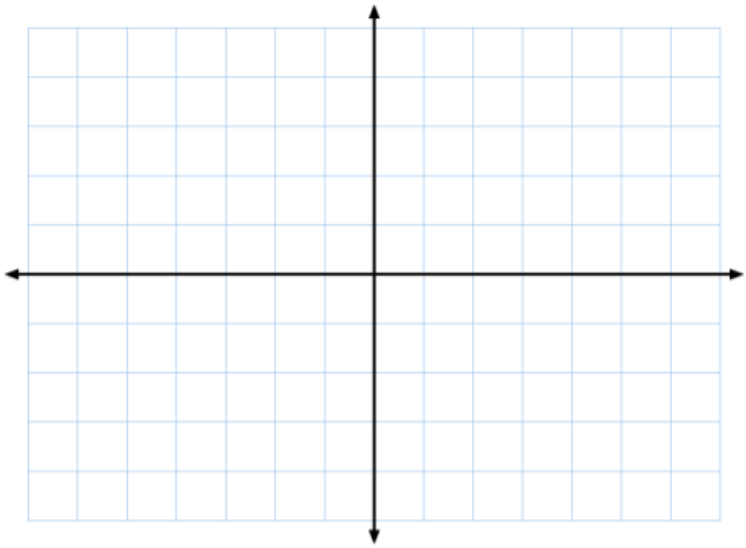
Graphing Review:

Graph the following: y = 2x - 1 x,y ε R

1. Table of Values:

X	Y
-2	
-1	
0	
1	
2	

2. Graph the co-ordinates:



Oct 13-1:42 PM

Domain & Range:

Domain - set of all possible x values

Range - set of all possible y values

- When writing domain and range in set notation they should be written in order of smallest to largest. Numbers should not be repeated.

What is the domain for the following ordered pairs? What is the range?

(2,1) (3,4) (5,6) (8,9) (10,11)

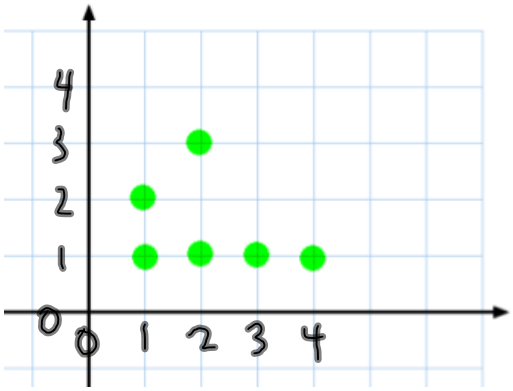
Domain =

Range =

Oct 13-1:48 PM

What is the domain for the following graph? What is the range?

(x,y) ⇒ always this order.



- least to greatest
- can't repeat #'s

Domain =

Range =

Oct 13-2:06 PM

Discrete & Continuous:

Discrete Data

- finite number of values in between 2 points
- every number is **not** possible
- easily "countable"
- dots on a graph

Examples:

- Number of books on a shelf
- Number of defective items in a shipment of 50 pens

Continuous Data

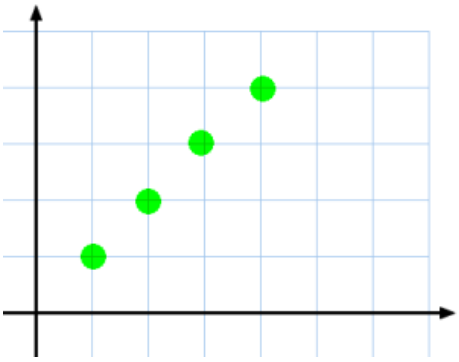
- infinite number of values in between 2 points
- every number **is** possible
- dots are joined

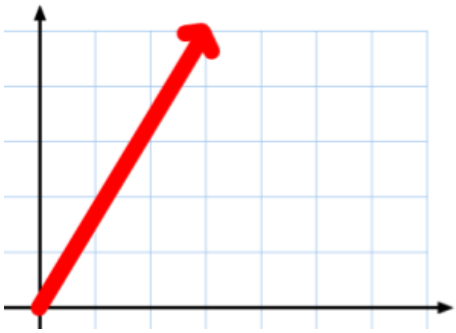
Examples:

- 1-5 and everything in between
- timing for a 100 m dash

Oct 13-2:18 PM

Is this a graph of Discrete or Continuous Data?





Oct 13-2:23 PM

Practice:

1. What is the domain & range of the following set of ordered pairs?

(2,1) (3,2) (8,9) (3,10) (1,3) (3,6) (2,10)

2. Are the following situations discrete or continuous?

a) The height of trees at a nursery over a period of 20 years
b) The number of correct answers on a student's multiple choice quiz
c) How many times it would take a person to pass their driver's test
d) The length of time it takes for a light bulb to burn out

Oct 13-2:25 PM

Class work / Homework:

Complete worksheet:

"Section 3.1 - Domain & Range, Discrete & Continuous"

Domain, Range, Continuous & Discrete worksheet #2.doc

Oct 13-2:39 PM

Questions:

1. List the domain and range in set notation for each of the following sets of ordered pairs.

a) {(2,1) , (-1, 3) , (4, 2) , (3,-2)}

b) {(0,2) , (-1,-1) , (3,2) , (2,3)}

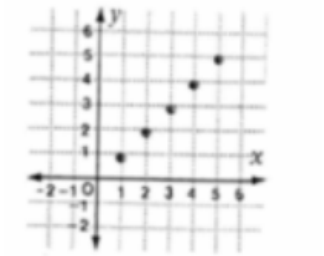
2. List the domain and range in set notation for the table of values.

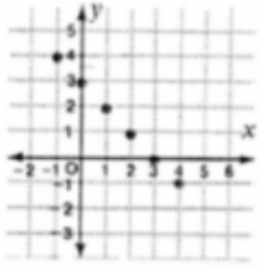
X	3	3	4	5	3	4	5	4	5	5
Y	1	1	1	1	2	2	2	3	3	4

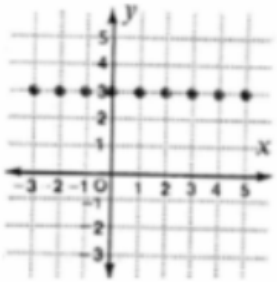
Oct 13-3:01 PM

3. List the domain and range in set notation for each of the following graphs.

a) b) c)







4. Graph the following equations by creating a table of values.
Determine if the data is either discrete or continuous.

a) $x + y = 4$ $x, y \in N$

b) $x + y = 3$ $x, y \in I$

c) $x + y = 2$ $x, y \in R$

d) $x - y = 2$ $x, y \in R$

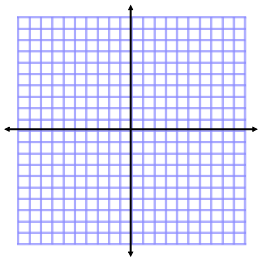
Oct 16-9:57 AM

Example 1: Make a table of values and graph

$y = 4x - 5$ $\quad x,y \in I$ → "x" values must be:

x	y=4x - 5	y

Coordinates:



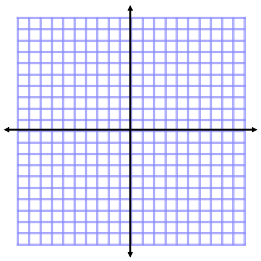
Example 2: $x - y = 5$ $\quad x,y \in W$

- You need to rearrange this so that it is y= ___

$x - y = 5$

x	y

Coordinates:



Oct 16-1:05 PM

Class work / Homework:

For each of the following make a table of values and graph the coordinates. Copy these down.

(1) $y = -2x - 1$ $\quad x,y \in I$

(2) $y = 3x + 2$ $\quad x,y \in W$

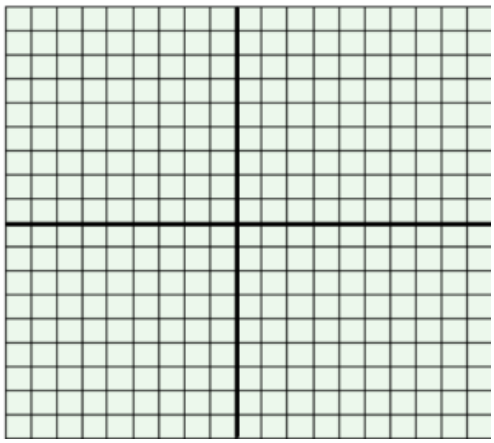
(3) $y = -1x - 2$ $\quad x,y \in N$

(4) $x + y = -2$ $\quad x,y \in R$

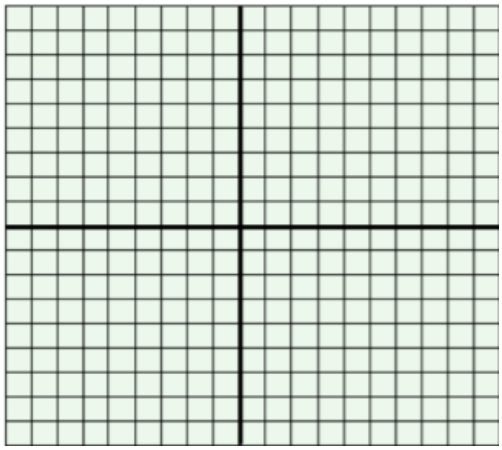
Oct 16-1:23 PM

3. Graph the following equations. Determine if the data is either discrete or continuous.

$y = 2x + 3 \quad x,y \in I$



$y + 5x = 7 \quad x,y \in R$



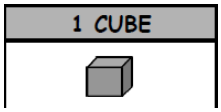
Oct 14-5:21 PM

Investigation #1:

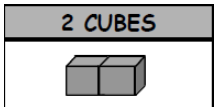
Finding a Pattern: we will use a pattern to make predictions about trains constructed from cubes.

Together As a Class.....

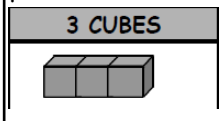
A. Place one cube on the desk. How many faces are visible?



B. Use two cubes to make a train on the desk. How many faces are visible?



C. Create more trains. Each train will have one cube more than the previous train. Record the number of visible faces on each train.



Number of Cubes	1	2	3	4	5	6	7
Number of Visible Faces	5						

What pattern do you see in the sequence of numbers you collected?

sequence = a set of numbers arranged in order according to a pattern or rule.

Oct 13-7:31 PM

Investigation Questions:

1. How many visible faces are there for a train of 11 cubes?

2. What is the number of visible faces for a train of 12 cubes and for a train of 15 cubes?

3. List restrictions on possible values for the number of visible cubes.

4. Predict the number of visible faces for a train of 200 cubes.

Oct 13-8:17 PM

Class work / Homework:

Complete the following:

- Focus A - A, B, C (write the set notation for the domain and range), and D
- Focus Questions 5, 6, 7, 8 a, and 9
- Check your Understanding 13, 14, 16

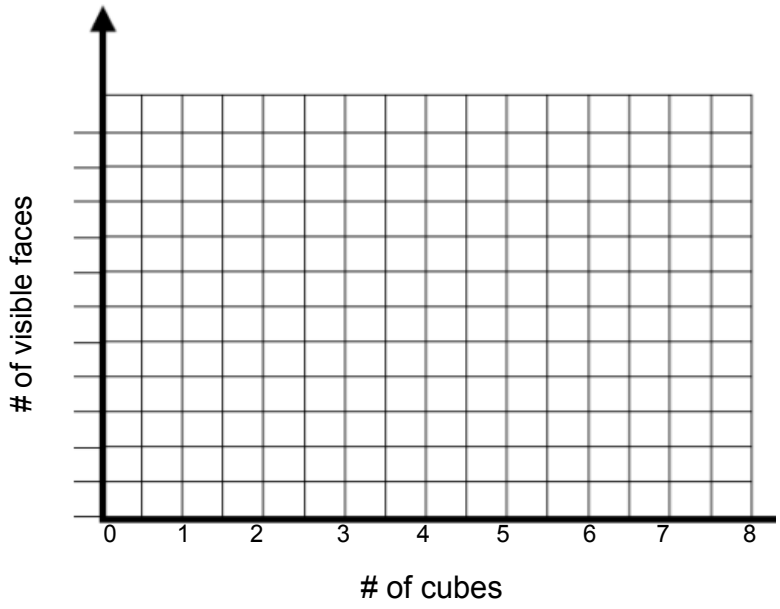
Oct 13-8:33 PM

- Focus A:

Answers:

A. On Cartesian plane, graph the table of values from Investigation #1:

Number of Cubes	1	2	3	4	5	6	7
Number of Visible Faces	5	8	11	14	17	20	23



B. Should you join the points on the graph (determine whether the data are continuous or discrete)?

Oct 13-8:17 PM

C. Write the set notation for domain and for the range.

D. Describe the patterns shown on the graph:

a) geometric pattern

b) display of patterns from the table of values

c) why are all the points in the first quadrant

Oct 14-7:17 PM

- Focus Questions:

5. a) Use your graph to find the number of visible faces for a train with 18 cubes.

   b) Explain how you found your answer. Is a graph teh best way to do this? Explain.

   c) How confident are you that your answer is correct?

6. What is the most reasonable way to find the number of visible faces for a train of 200 cubes? Explain.

7. I it easier to use a graph or a table of values to make predictions for a large number of cubes? Explain.

Oct 13-8:32 PM

8. Suppose you were asked to find the number of visible faces for a train with 1000 cubes.

   a) Explain why it would not be practical to use a cube model, table of values, or graph to find the number of visible faces.

9. Look at the pattern in the trains. Find the number of visible faces for each of the following trains.

a) 22 cubes b) 30 cubes c) 40 cubes

d) 50 cubes e) 60 cubes f) 70 cubes

Oct 13-8:16 PM

Creating Equations Terminology:

- Sum
- Product
- Difference
- Plus
- Doubled
- The result is
- Is the same as
- Tripled
- Diminished by
- Quotient
- Decreased by
- Take a half
- Trebled

Oct 19-3:26 PM

Creating Equations Examples:

a) a number increased by 8.

b) John's age 3 years from now.

c) Three times the volume decreased by 10.

d) The value, in cents, of x nickels.

e) One-half of the age Susan was 2 years ago.

Oct 19-3:28 PM

Creating Equations:

1. Three times a number.
2. A number increased by 4.
3. A number decreased by 3.
4. The length increased by 5m.
5. Mary's age 2 years ago.
6. John's age 5 years from now.
7. Twice the width increased by 3.
8. One-half the speed.
9. Eight points less than the winner.
10. Three times the volume decreased by 20.
11. The value, in cents, of x quarters.
12. One third of Tom's age 10 years from now.
13. Six times a number decreased by 2.
14. Four times as many people.
15. Twice a number decreased by 7 equals 41.
16. 19 is subtracted from 3 times a number and the result is -1.
17. When a number is multiplied by 7, and 35 is subtracted from the product, the result is 59.

Oct 19-3:21 PM

18. If you add 19 to a number the sum is the same as if you add 7 to twice the number.
19. Five times a number plus 19 equals nine times the number minus 41.
20. Three times a number is 45.
21. One-half of a number is 16.
22. Five times a certain number is 45.
23. If a number is doubled and 3 added, the result is 25.
24. If 8 is subtracted from $\frac{3}{4}$ of a certain number, the result is 7.
25. When I double a certain number and add 16, the result is 40.
26. The number of pupils in a class is 33 and the number of boys is 7 greater than the number of girls.
27. If 37 is added to a certain number, the sum is 53.
28. If 27 is subtracted from a number, the result is 5.
29. When a number is multiplied by 7 and 25 subtracted from the product, the result is 59.
30. If five times a number is increased by 6, the sum is the same as if twice the number were increased by 15.
31. If you add 19 to a certain number the sum is the same as if you add 7 to twice the number.

Oct 19-3:24 PM

Warm-up

1. What type of geometric pattern do we see on the following graph?

2. Write the expression for each of the following:
   a. 10 more than five times a number
   b. Helen's age 2 years ago
   c. One fourth of a number which has been increased by three
   d. When a number is multiplied by 6, and 25 is subtracted from the product, the result is 43.

Oct 21-8:30 AM

Investigation #3:

Problem

After researching the rates of different Internet providers, Daniella decided to use Company A. Company A charges $20.00 per month plus $2.00 per hour. Daniella's first monthly bill was $80.00. How many hours was she on-line in the first month?

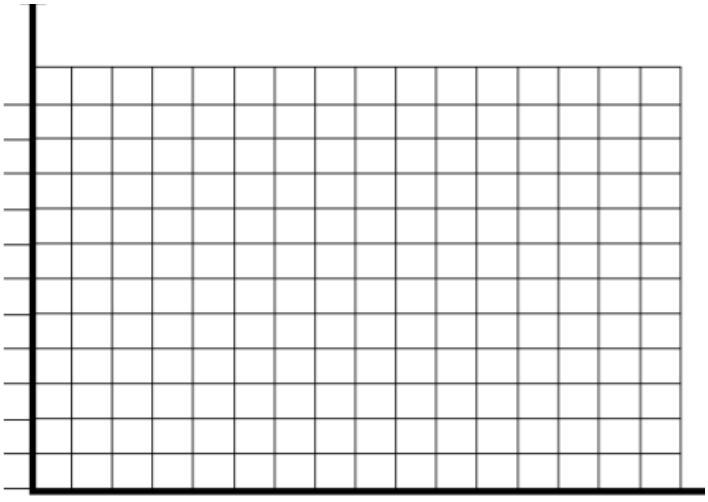
1. Determine the cost of using the internet by completing the table below.

2. Create a graph using the data from the table of values.

Hours (h)	Cost (C)
0	
1	
2	
3	
4	
5	
6	

a) What is the independent variable? _____

b) What is the dependent variable? _____



Oct 13-8:15 PM

Fill in the table below with the appropriate information pertaining to the graph above.

	Continuous or Discrete Data?	Independent or Dependent Variable?	Domain or Range?
Time in hours (t)			
Total Cost in $ (c)			

a) Describe the Domain and Range.

3) Write a formula (using words) to find the cost of Internet use if the number of hours used in one month is known.

Total Monthly Charge =

4) Write an equation (variables and numbers) to show the number of hours of Internet use for Daniella's bill of $80.00.

Equation = a mathematical sentence showing that expressions are equal in value. The variables are represented by letters.

Oct 13-9:02 PM

Example #1: Making an Equation

Ralph rents snow boards for $3.50 per hour, but requires a $2.00 non-refundable deposit. How much money will it cost you to rent Ralph's snow board and use it for 2 hours? How about 3 hours, 6 hours?

1) must figure out what we are looking to solve for, and give it a letter.

2) must then write out how that solution is to be discovered.

3) must then make it into a formula that will be useable for any finding.

4) The equation should then be tested. Try to solve for 3, 6, and 10 hours.

Oct 13-9:03 PM

Practice: Page 101, Question #18

An Internet provider charges $20.00 per month plus #2.00 for each hour of use. After how many hours would you be charged $60.00 for the use of the Internet? Show all of your work.

1) must figure out what we are looking to solve for, and give it a letter.

2) must then write out how that solution is to be discovered.

3) must then make it into a formula that will be useable for any finding.

4) The equation should then be tested. Try to solve for how many hours you would have used the Internet to be charged $60.00.

Oct 13-9:01 PM

Class work / Homework:

Complete the following:

- Check Your Understanding pg. 102
  #'s 19, 20, 21, 22, 23, 24, 25 (a and c)

Oct 13-9:00 PM

Pg. 102 # 19

- $2.50
- $2.00 (# of km)
→ $31.50

$C = 2x + 2.5$ ← Solve for x

$31.50 = 2x + 2.5$
$-2.5 \quad -2.5$

$\frac{29}{2} = \frac{2x}{2}$ $\quad x = 14.5$

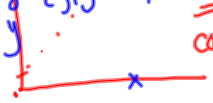
The taxi traveled 14.5 km.

$C = 2x + 2.5$

x	$y = 2x + 2.5$	y	Copy
0	$y = 2(0) + 2.5$	2.5	(0, 2.5)
1	$2(1) + 2.5$	4.5	(1, 4.5)
2	$2(2) + 2.5$	6.5	(2, 6.5)
3	$2(3) + 2.5$	8.5	(3, 8.5)
4	$2(4) + 2.5$	10.5	(4, 10.5)

domain $\{x \mid x = 0, 1, 2, 3, 4, x \in R\}$
range $\{y \mid y = 2.5, 4.5, 6.5, 8.5, 10.5, y \in R\}$

contin.



Oct 22-8:48 AM

(20) - $200
- $50/hr

$C = 50x + 200$

$525 = 50x + 200$
$-200 \quad -200$

$\frac{325}{50} = \frac{50x}{50}$

$6.5 = x$

They will play for 6.5 hrs.

(21) - $10 000
- $2.00/cd

$C = 10\,000 + 2x$
$C = 2x + 10\,000$ ←

$C = 2(50\,000) + 10\,000$
$C = 100\,000 + 10\,000$
$C = 110\,000$

(a) She would earn $110 000.

(b) $C = 2x + 10\,000$
$40\,000 = 2x + 10\,000$
$-10\,000 \quad -10\,000$
$30\,000 = 2x$
$\frac{30\,000}{2} = \frac{2x}{2}$
$15\,000 = x$

She sold 15 000 cds.

Oct 22-9:04 AM

Write an equation to represent each of the following situations:

a) Your neighbor pays $5 per hour to their babysitter. If t= total amount made and x = number of hours you were babysitting, what would the equation look like? $t = 5x$

b) Greco delivers pizza for $5 flat fee and $8 per medium pizzas ordered. If t = total amount and x = number of medium pizzas, what would the equation look like? $t = 8x + 5$ $t = 5 + 8x$

c) Standard Taxi charges $4 pick up fee and $1.25 per kilometer. If t = total amount and x = number of kilometers driven, what would the equation look like? $t = 1.25x + 4$ ✓ $t = 4 + 1.25x$

Oct 21-10:30 PM

Warm Up:

1. You are the manager at the school store. You are asked to prepare a report to predict t-shirt sales for November. In September you sold 6 t-shirts on day 1 and 5 t-shirts more every day after that for the month of September.

a) Create a table of values to represent this relationship till day 10.

Day	1	2	3	
t-shirts sold	6	11		

b) Is the data found in the table of values continuous or discrete?

c)Write the domain in set notation and state what type of numbers it is from.

d) Write the range in set notation and state what type of numbers it is from.

e) Create an equation to represent this relationship.

f) On day 21 how many t-shirts did you sell in September? Show all work.

Oct 13-9:42 PM

Warm-Up

Pg. 102
#24 - Read question

- make an equation
- answer (a)
- make a table of values
- graph it (doesn't need to be on graph paper)
- do we join the dots?
- state the domain + range
- Is it discrete or continuous?
- What is the geometric pattern?

Oct 22-9:19 AM

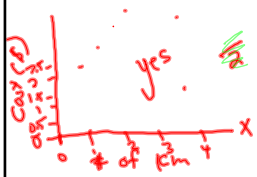
$C = 0.50x + 3$

(a) $32 = 0.5x + 3$
$-3 \quad -3$

$\frac{29}{0.5} = \frac{0.5x}{0.5}$ $x = 58$

The distance was 58 km

x	$y = 0.5x + 3$	y
0	$0.5(0) + 3$	3
1	$0.5(1) + 3$	3.5
2	$0.5(2) + 3$	4
3		4.5
4		5



domain $\{x \mid x = 0, 1, 2, 3, 4, 17, x \in R\}$

range $\{y \mid y = 3, 3.5, 4, 4.5, 5, 17, y \in R\}$

Continuous

Linear

Oct 22-8:33 AM

Attachments

Domain, Range, Continuous & Discrete worksheet #2.doc